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(54) METHOD AND SYSTEM FOR AUTOMATED TECHNICAL SUPPORT FOR COMPUTERS

(75) Inventors: Thomas Vrhel, Jr., Austin, TX (US); Gary D. Huber, Austin, TX (US); Roy W. Stedman, Austin, TX (US); James Van Artsdalen, Austin, TX (US); Krishnamurthy Venkatramani, Austin, TX (US)

(73) Assignee: Dell USA, L.P., Round Rock, TX (US)

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(58) Field of Search 714/26, 27, 32, 714/34, 36, 37, 40, 46, 55, 23

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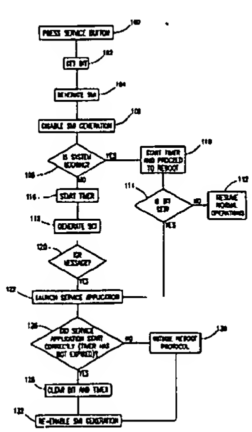
Primary Examiner—Robert Beausoliel
Assistant Examiner—Marc M Duncan
(74) *Attorney, Agent, or Firm*—Baker Botts L.L.P.

(57) ABSTRACT

A method and system for automated support in a computer system. The computer system has a service button, and pressing of the service button causes a bit to be set in a register in the chip set. Setting of the bit generates an interrupt signal that is received and processed in a manner dependent on whether the computer system is in a booting state or a non-booting state. If the computer system is in a booting state, the bit is checked at a predetermined point in the booting sequence, and if set, a service application is initiated at that time. If the computer is not in a booting state, a second interrupt is generated, causing the service application to be initiated. A timer is initiated substantially with pressing of the service button, and if the service application reaches a predetermined point before the timer reaches a predetermined value, it will clear the timer. If not, the system will follow a predetermined reboot protocol.

31 Claims, 3 Drawing Sheets



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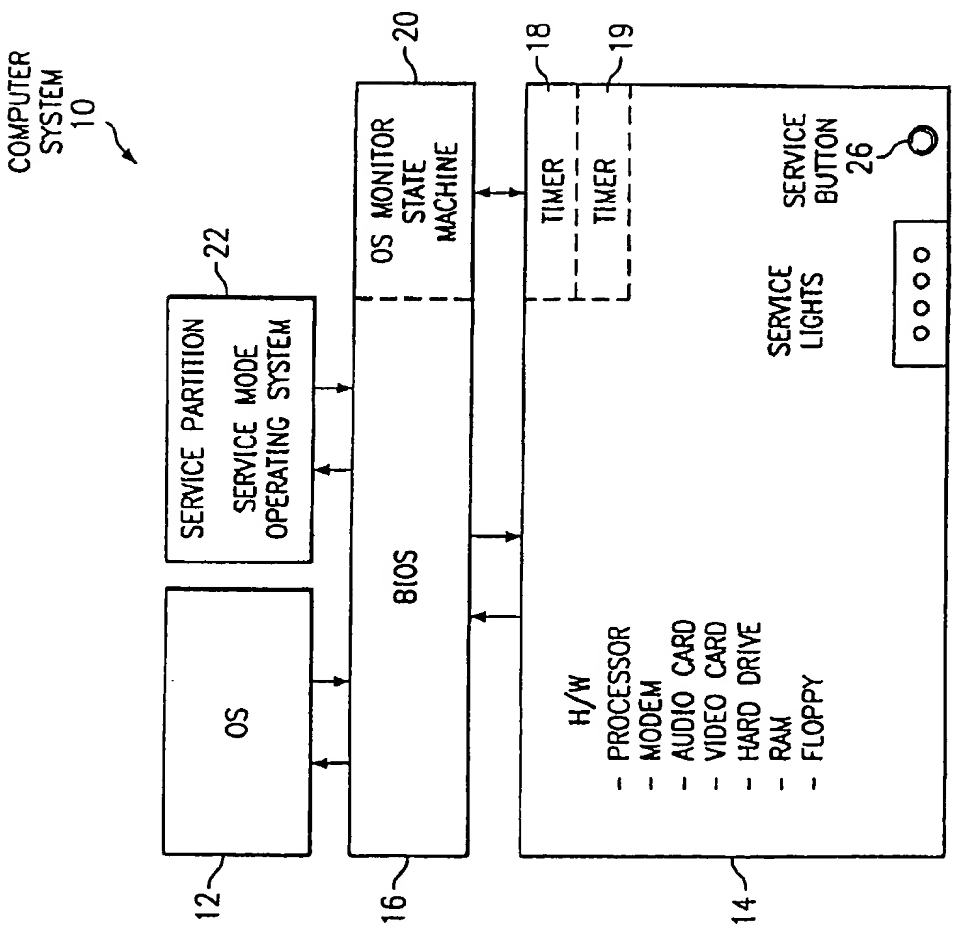
COMPUTER SYSTEM 10
22
SERVICE PARTITION
SERVICE MODE OPERATING SYSTEM
OS
12
20
OS MONITOR STATE MACHINE
BIOS
16
18
19
TIMER
TIMER
SERVICE BUTTON 26
SERVICE LIGHTS
H/W
- PROCESSOR
- MODEM
- AUDIO CARD
- VIDEO CARD
- HARD DRIVE
- RAM
- FLOPPY
14

FIG. 1

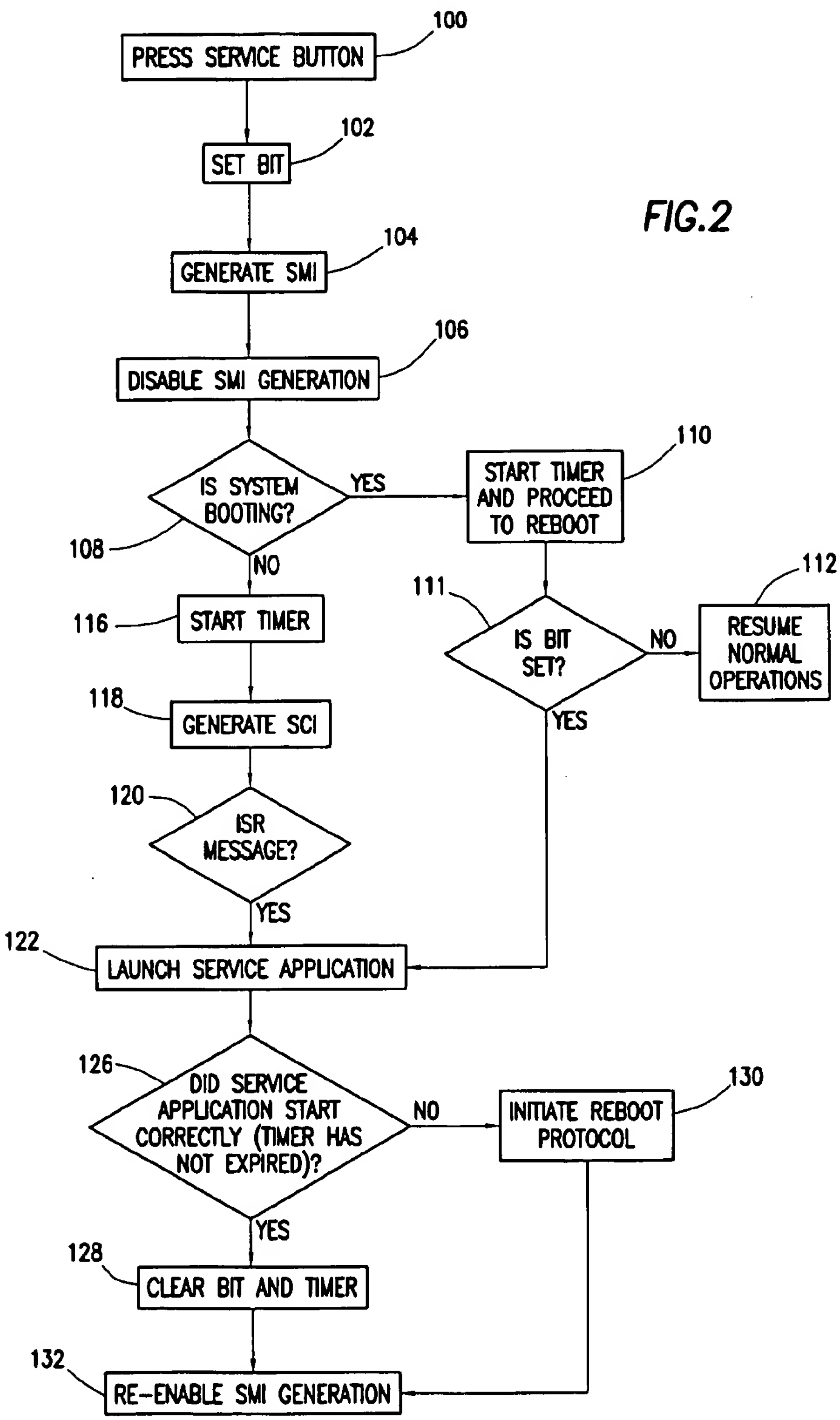
PRESS SERVICE BUTTON
100
SET BIT
102
GENERATE SMI
104
DISABLE SMI GENERATION
106
IS SYSTEM BOOTING?
108
YES
START TIMER AND PROCEED TO REBOOT
110
NO
START TIMER
116
IS BIT SET?
111
NO
RESUME NORMAL OPERATIONS
112
YES
GENERATE SCI
118
ISR MESSAGE?
120
YES
LAUNCH SERVICE APPLICATION
122
DID SERVICE APPLICATION START CORRECTLY (TIMER HAS NOT EXPIRED)?
126
NO
INITIATE REBOOT PROTOCOL
130
YES
CLEAR BIT AND TIMER
128
RE-ENABLE SMI GENERATION
132

FIG.2

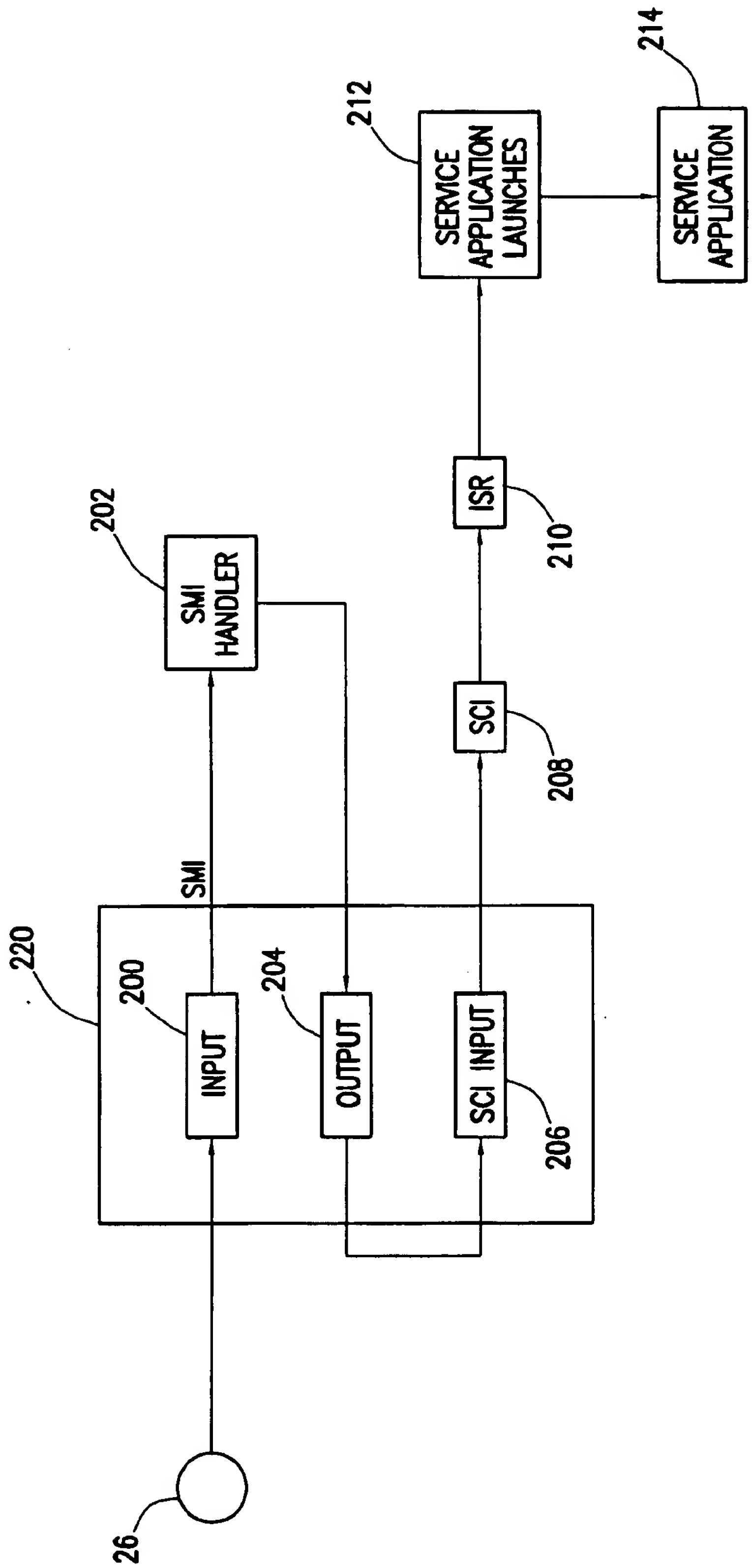
214
212
SERVICE APPLICATION LAUNCHES
SERVICE APPLICATION
202
SMI HANDLER
ISR
210
SCI
208
SMI
220
200
INPUT
204
OUTPUT
SCI INPUT
206
26

FIG.3

METHOD AND SYSTEM FOR AUTOMATED TECHNICAL SUPPORT FOR COMPUTERS

TECHNICAL FIELD

This patent application relates in general to the field of computing devices, and more particularly to a method and system for automating support for computers.

BACKGROUND

Personal computer systems have become increasingly common in businesses and households. Although the term "personal computer" implies a generic device, "personal computers" generally have a wide diversity of hardware and software components. For instance, different personal computers may have processors and buses of different speeds, hard drive and RAM memories of different sizes, and peripheral devices interfaced with different types of interface cards, such as audio devices. Further, a large array of manufacturers produce computer components so that in a given personal computer, even components having substantially similar operating characteristics may have important differences based on each component's manufacturer specification.

With respect to software, generally all personal computers have a common need for an operating system that coordinates the operation of hardware components. However, each individual personal computer may have one of many possible operating systems. For instance, Microsoft products have evolved from its original Disk Operating System ("DOS") to Windows systems, including Windows 3.1, Windows 95, Windows 98, Windows CE and Windows NT. In addition to these Microsoft operating systems, other types of operating systems are available, such as different versions of Unix, including Linux.

In addition to this wide diversity of operating systems, personal computers may operate a large number of different types of software applications. A given software application may interact in different manners with different operating systems. Thus, even with substantially similar hardware components, personal computers having different software may operate in substantially different manners.

Computer users can experience difficulties in system operation for many reasons. Lack of knowledge, hardware faults, software incompatibilities, and many other causes can lead to problems for the computer user. Given the wide range of hardware and software available (which implies an even greater range of hardware/software combinations that a user can experience), it is difficult to determine if the computer has a problem.

This situation is further complicated by the fact that personal computers do not have good mechanisms to automatically determine if the hardware/software system is having a problem. While certain operating systems contain code that help sense some types of problems with specific pieces of hardware, such mechanisms may be insufficiently uniform for determining if the operating system has a problem. Indeed, a common symptom of an operating system problem is a failure to boot, in which case the OS cannot be counted on to help. Another common symptom of an operating system problem is a hang, in which case the operating system becomes unresponsive to the keyboard and mouse for a wide variety of possible causes. It should be noted that this type of problem can be caused by pieces of software which have been installed on top of the operating system, such as an application or driver, or some incompatibility between pieces of software that have been loaded. A system that was operational may stop functioning at some later point due to software incompatibilities.

Another issue is the lack of a uniform mechanism for the user to invoke assistance. If the user has a question or the system has a problem, or at least the user perceives a problem, there is currently no uniform mechanism to get the system to attempt to provide assistance to the user. Although there are various types of help available to the user, they rely on one or more working input devices, such as a mouse and/or a keyboard, and a sufficient level of user knowledge to be able to navigate to one of a variety of information sources on the system and on a global information source such as the internet.

SUMMARY

Therefore, a need has arisen for a method and system for identifying and resolving personal computer system problems that is accessible through a uniform fail-safe mechanism regardless of the functional state of the operating system and other software, and can be implemented on a wide variety of operating systems

A further need exists for a method and system that detects when an operating system has failed to boot or has hung and can take appropriate corrective actions.

A further need exists for such a system that includes a monitoring system that communicates with the operating system and vice versa, and that is capable of doing so with a wide variety of different operating systems.

A further need exists for such a standard mechanism that will attempt to resolve operating system hang conditions regardless of whether the assistance has been requested by the user during boot or otherwise, and regardless of whether the user has made multiple requests for assistance.

In accordance with the present disclosure, a method and system is provided that substantially eliminates or reduces disadvantages and problems associated with previously developed methods and systems for identifying computer system problems. A monitoring system detects problems with a computer system and aides in identifying and resolving the problems. The current level of functionality of the computer system is determined, and technical support is provided for the computer system in accordance with the functionality of the computer system.

For example, in one embodiment, a user initiates operating system monitoring by pressing a service button to indicate a problem with the computer system. The pressing of the service button initiates support functions, such as the initiation of a service application, at an appropriate time. The support functions allow testing of.the computer system by the monitoring system. The service button initiates a watchdog timer that acts as a hang detection timer. An operating system hang-up error is identified if the hang detection timer remains uncleared after a predetermined hang detection time. Detection of a computer failure results in the system following a predetermined reboot protocol, such as that described in co-pending U.S. application Ser. No. 09/377,726, which is incorporated herein by reference.

More specifically, in one embodiment a method for automated support is provided in a computer system having a service button and a controller chip set. The method includes the steps of pressing the service button, setting a first bit in a general purpose input register in the controller chip set to generate a first interrupt signal in response to the pressing step, receiving the first interrupt and determining whether the computer system is booting, and if the system is booting

then initiating a service application routine in a first manner, or if the system is not booting then initiating a service application routine in a second manner.

A method is also provided for automated support of a computer system having a controller chip set including the steps of pressing a service button, setting a bit in a general purpose input register in the chip set, generating a first interrupt of a first type as a result of the bit being set, and initiating a service application in a manner dependent on whether the computer system is booting or not.

A computer system is also provided having a processor with at least one timer, a controller chip set, a system BIOS, and an operating system for communicating with components of the computer system through the BIOS. A service button is coupled with a general purpose input register in the chip set for setting the register for generating a first interrupt. The system further includes an interrupt handler that is coupled to the input register for receiving the first interrupt and processing it in a manner dependent on whether the computer system is in a booting state or a nonbooting state.

A computer system having a system BIOS and an operating system is also provided, wherein the computer system includes a service button coupled to a general purpose input register in a controller chip set for setting a bit in the register to generate a first interrupt signal. An interrupt handler in the system BIOS receives the first interrupt signal and initiates a second interrupt signal to the operating system to initiate a service application if the computer system is not in a booting state. If the computer is in a booting state the bit remains set, and code contained within the operating system checks the status of the bit later during the booting sequence and initiates the service application if the bit has been set.

The present invention provides many important technical advantages. One important technical advantage is integrated support for detecting problems associated with computer systems. One such advantage is a robust user interface that is simple and uncomplicated to use. For instance, a user with a question or problem simply pushes a single service button. Pressing the service button generates an interrupt directly into the chip set to alert the monitoring system that service is requested by the user. The direct interface of the service button to the chip set enhances reliability and simplicity, as the user's input to the service button does not have to rely on the operation of computer components, such as a keyboard or mouse. Additionally, a user may press the service button at any time to seek assistance. The means by which pressing of the service button initiates a service application ensures that the service application will be run at the appropriate time, regardless of when the service button is pressed, and regardless of whether it is pressed multiple times. Further, the system and method of the present invention can be easily implemented with a variety of different operating systems.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the present invention and advantages thereof may be acquired by referring to the following description taken in conjunction with the accompanying drawings, in which like reference numbers indicate like features, and wherein:

FIG. 1 depicts a block diagram of a computer system monitored by an operating system monitor state machine;

FIG. 2 depicts a flow diagram of initiation of a service application following pressing of a service button; and

FIG. 3 depicts a block diagram of software and hardware elements used to initiate a service application.

DETAILED DESCRIPTION

Preferred embodiments of the present invention are illustrated in the Figures, like numeral being used to refer to like and corresponding parts of the various drawings.

A healthy operating system monitors hardware and software operations on a computer system. At times, the operating system detects difficulties or problems with the computer system and provides notice of the difficulties or problems to the computer system user. Help systems generally associated with the operating system can help to resolve difficulties or problems either automatically or through user interaction, such as by asking questions. However, when the operating system itself has a problem or there are software incompatibilities, it is difficult for the operating system to address those problems. Frequently, the operating system either shuts down or hangs up without providing further notice of the problem to the computer system user.

To improve computer system problem detection, identification and resolution, a monitoring system associated with the computer system's BIOS monitors operating system functionality. The monitoring system detects operating system boot failures and various types of operating system hang-ups. Once a problem is detected, remedial action is automatically taken to recover a failed computer system using a uniform mechanism that takes advantage of operational aspects of the computer system. For instance, a single push of a service button provides an interrupt to the computer system chip set for automatically invoking the highest available level of user assistance as determined by computer system health and state. The service button may be pressed by a user while the computer system is in POST, booting, in service mode or in normal mode. When the service button is pressed, the BIOS sets a bit in a general purpose input register in the controller chip set and generates an interrupt. State-sensitive interrupt handler code in BIOS takes appropriate action, and may communicate to the operating system, depending upon the state of computer system as represented by certain CMOS bits. Further, the interrupt handler code ensures that only appropriate action is taken regardless of the number of times the service button is successively pressed. The manner in which the service button invokes user assistance will now be described in more detail with reference to FIGS. 1–3.

Referring now to FIG. 1, a block diagram depicts a computer system **10** having an operating system **12** interfaced with hardware components **14** through a basic input output system ("BIOS") **16**. Hardware components **14** include conventional personal computer system hardware components such as a processor, modem, audio card, video card, and storage devices, including a hard drive, floppy drives, ROM and RAM. On initial power-up or upon initiation of a reboot, BIOS **16** directs a boot sequence, including a power on self test ("POST") and calling of the operating system. Within hardware **14** resides one or more timers **18** and **19**, such as conventional watchdog timers.

Computer system **10** includes a service button **26** available for a computer user to press. Service button **26** provides a robust user interface that enables a user to initiate the problem detection and identification process. Service button **26** generates an interrupt into the computer system chip set to, for instance, initiate a service application. Monitor state machine **20** detects pressing of the service button and launches the service application at an appropriate time, or monitors the system behavior to detect computer system problems. Monitor state machine **20** monitors the function-

ing of operating system 12 with a watchdog or "hang detection" timer 19. When the service button is pressed, hang detection timer 19 is initiated, and is later cleared by an application run after completion of the calling up and booting of operating system 12 or service mode operating system 22. If the application does not clear hang detection timer 19 within a predetermined period of time, monitoring state machine 20 determines that an operating system hang-up has occurred. BIOS 16 then recognizes an operating system problem and initiates a predetermined reboot protocol, such as that described in co-pending U.S. application Ser. No. 09/377,726, which is incorporated herein by reference.

As indicated above, the service button provides a standard mechanism through which a user can invoke assistance. Referring now to FIGS. 2 and 3, a user who seeks to invoke assistance will press service button 26 at step 100. Note that although not specifically shown, the flow chart depicted in FIG. 2 involves two execution spaces, one within the BIOS and the other within the operating system execution space. In general, communication to the operating system is handled by generating an interrupt, such as a system control interrupt (SCI), while communication from the operating system back to the BIOS is accomplished by running code that sets values in the BIOS, such as clearing a hang detection timer. The means by which the monitoring system in the BIOS communicates with the operating system and the operating system responds (if not hung), as will be more fully described below, provides unique advantages. Although the system is of necessity operating-system dependant since some portions reside within the operating system, it is also capable of leveraging the underlying personal computer architecture to allow the same mechanism in the BIOS to support multiple operating-system specific implementations. Further, the system enables user assistance to be invoked regardless of the functional state of the operating system.

As shown in FIG. 3, the service button 26 is wired directly to a specific input register 200 in the general purpose input/output register (GPIO) of the controller chip set 220, and pressing of the service button causes a bit in that input register to be set at step 102. The setting of this bit generates a system management interrupt (SMI) at step 104 to initiate state-sensitive interrupt handler code, an SMI handler 202, in the BIOS. The SMI handler 202 receives the SMI, and disables further SMI generation at step 106 until the present SMI has been serviced to ensure that if a user presses the service button multiple times, only one interrupt will be generated until that interrupt has been fully serviced.

At step 108, the SMI handler determines whether the computer system is booting by examining the appropriate bit in the CMOS register. If the system is currently booting, the general purpose input bit remains set while the system continues its boot sequence. A hang detection timer is also set at step 110, but the SMI handler takes no further action. When the system completes its boot sequence, or at a predetermined point in the booting sequence where it is known that hardware and software tested and run up to that point in the boot sequence are generally operational, such as when the user is prompted for a login ID, the operating system is directed to check the status of the service button bit at step 111. If the service button bit has been set, indicating that the button was pressed during boot, the operating system will launch a service application at step 122, otherwise it will resume normal operations (step 112). In one embodiment, a background task such as a service application launcher associated with the operating system, which is run as part of the normal boot process, checks the service button bit. If the service button bit is set, the service application launches the service application.

If, at step 108, the SMI handler determines that the system is not booting, the SMI handler initiates a hang detection timer at step 116. This hang detection timer could be the same timer as would be set in step 110 above or a different timer. The value to which the timer is set, however, will be different depending on whether the service button was pressed during boot or otherwise. If pressed during boot it will be set to a higher value, representing the longer amount of time required to allow the system to complete the boot cycle and launch the service application. If not pressed during boot, the timer will be set to a lower value, representing the shorter amount of time required to allow the system to process the interrupt (described below) and start the service application.

If the system is not booting, the SMI handler code in the BIOS subsequently communicates with the operating system by causing an interrupt at step 118. In one embodiment, this interrupt is a system control interrupt (SCI) that is serviced in operating system execution space. To initiate the SCI, the SMI handler sets an output bit 204 in an output register in the GPIO. As shown in FIG. 3, this bit is used as an input to a system control interrupt input 206, which in turn initiates the SCI 208. At step 120, the SCI is processed by an interrupt service routine (ISR) 210 in the operating system execution space. The ISR provides a message to the operating system to initiate a service application. In one embodiment this is achieved by sending a message to the service application launcher 212 associated with the operating system, which starts the service application 214 at step 122.

Regardless of whether the service button was pressed during boot or otherwise, if the service application starts correctly, as determined at step 126, the service button bit and hang detection timer are cleared at step 128. In one embodiment, the service application notifies the service application launcher and instructs it to clear the service button bit and the hang detection timer. If the service application has not started correctly (the timer has reached zero before being cleared), it may indicate an operating system hang-up or, at minimum, that it is incapable of properly starting the service application. Thus, the system begins to follow a predetermined reboot protocol in step 130, such as that described in detail in co-pending U.S. application Ser. No. 09/377,726, which is incorporated herein by reference. Finally, once the SMI has been fully serviced the SMI handler reenables SMI generation at step 132 so that subsequent pressing of the service button will cause another interrupt and initiate servicing as described above.

Thus, the system and method of the present invention provide a unique way in which to invoke user assistance in a uniform fail-safe way. The manner in which the code in the BIOS execution space communicates with the operating system and vice versa enables invocation of a service request that is operating system independent, and provides a monitoring system that is outside of the operating system so as to be able to monitor the operating system itself. Further, the system and method described above enables a user to invoke assistance regardless of the state of the operating system (i.e. during booting or otherwise, or when the operating system is hung).

Although the present invention has been described in detail, it should be understood that various changes, substi-

tutions and alterations can be made hereto without departing from the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

1. A method for automated support in a computer system having a service button and a controller chip set comprising the steps of:

pressing said service button;

setting a first bit in a general purpose input register in the controller chip set to generate a first interrupt signal in response to said pressing step;

receiving said first interrupt signal; and

determining whether or not said computer system is executing a booting sequence, wherein:

if said computer system is not executing said booting sequence, then generating a second interrupt signal, said second interrupt signal initiating an interrupt service routine, and said interrupt service routine initiating a service application; or

if said computer system is executing said booting sequence, then checking the status of said first bit at a predetermined point during the booting sequence; and if said first bit is set, initiating said service application at a predetermined time during said booting sequence.

2. The method according to claim **1**, further comprising the step of initiating a timer in response to said pressing step.

3. The method according to claim **2**, further comprising the step of clearing said timer if said service application reaches a predetermined point before said timer reaches a predetermined value.

4. The method according to claim **3**, further comprising the step of initiating a predetermined reboot protocol if said service application has not reached said predetermined point prior to said timer reaching said predetermined value.

5. The method according to claim **1**, wherein said second interrupt signal is a system control interrupt, and said step of initiating said system control interrupt further comprises the step of setting a second bit in a general purpose output register of said controller chip set, said setting of said second bit causing the generation of said system control interrupt.

6. The method according to claim **1**, further comprising the step of disabling generation of subsequent first interrupt signals until said first interrupt signal has been processed.

7. The method according to claim **6**, wherein said computer system further includes a system BIOS, and wherein an interrupt handler in said system BIOS receives said first interrupt and performs said determining and disabling steps.

8. A method for automated support in a computer system having a controller chip set comprising the steps of:

pressing a service button;

setting a bit in a general purpose input register in said chip set;

generating a first interrupt of a first type as a result of said bit being set; and

determining whether or not said computer system is executing a booting sequence, wherein:

if said computer system is executing said booting sequence, then initiating a service application at a predetermined point during said booting sequence, otherwise

if said computer system is not executing said booting sequence, then generating an interrupt of a second type to initiate said service application.

9. The method according to claim **8**, wherein said interrupt of said second type is a system control interrupt, and wherein said method further comprises the steps of:

said system control interrupt initiating an interrupt service routine; and

said interrupt service routine causing initiation of said service application.

10. The method according to claim **9** further comprising the step of disabling generation of subsequent first type of interrupts until said first interrupt has been processed.

11. The method according to claim **9**, wherein said step of generating said system control interrupt further comprises the step of setting a bit in a general output register of said chip set, said output bit causing a third register to generate a system control interrupt signal to cause generation of said system control interrupt.

12. The method according to claim **11**, wherein an interrupt service routine receives said interrupt of said first type and performs said determining and disabling steps.

13. The method according to claim **12**, wherein said computer system further includes an operating system for supporting computer system operations and a system BIOS, said interrupt handler being in said system BIOS.

14. The method according to claim **13**, wherein said interrupt service routine is in said operating system.

15. The method according to claim **8**, further comprising the step of initiating a timer substantially when said service button is pressed.

16. The method according to claim **15**, further comprising the step of clearing said timer if said service application reaches a predetermined point before said timer reaches a predetermined value.

17. The method according to claim **16**, further comprising the step of initiating a predetermined reboot protocol if said service application has not reached said predetermined point prior to said timer reaching said predetermined value.

18. A computer system comprising:

a processor having at least one timer;

a controller chip set;

a system BIOS;

an operating system for supporting computer system operations and for communicating with components of said computer system through said BIOS;

a service button coupled with a general purpose input register in said chip set for setting said register to generating a first interrupt;

an interrupt handler, said interrupt handler being coupled with said input register for receiving said first interrupt and processing said interrupt in a manner dependent on whether the computer is in a booting state or a non-booting state.

19. The computer system according to claim **18**, wherein said interrupt handler comprises code in the system BIOS.

20. The computer system according to claim **19**, wherein said interrupt handler determines if said computer system is in said booting or said non-booting state, said interrupt handler being coupled with a general purpose output register in said chip set for setting a bit in said output register if said computer system is in said non-booting state.

21. The computer system according to claim **20**, wherein said general purpose output register is coupled with a third register in said chip set, said third register generating an interrupt signal for initiating a second interrupt when said bit in said output register is set.

22. The computer system according to claim **21**, wherein said second interrupt calls an interrupt service routine.

23. The computer system according to claim **22**, wherein said interrupt service routine is in said operating system.

24. The computer system according to claim **23**, wherein said operating system includes code for checking the status

of said input register at a predetermined time when said computer is in said booting state, and for initiating said service application if said register has been set.

25. The computer system according to claim **24**, wherein said interrupt service routine calls an application in said operating system, and wherein said application initiates said service application.

26. A computer system according to claim **25**, wherein said interrupt handler is coupled to said timer for initiating said timer substantially with receiving said first interrupt.

27. A computer system having a system BIOS and an operating system comprising:

a service button connected to a general purpose input register in a controller chip set for setting a bit in said register to generate a first interrupt signal;

an interrupt handler in said system BIOS for receiving said first interrupt signal and for initiating a second interrupt to said operating system to initiate a service application if said computer system is not executing a booting sequence; and

interrupt handler code contained in said operating system for checking the status of said bit during said booting sequence and for initiating said service application if said bit has been set.

28. The computer system according to claim **27**, wherein said interrupt handler code further comprises code for preventing said service button from generating subsequent interrupt signals until said first interrupt signal has been processed.

29. The computer system according to claim **28**, further comprising code for notifying said system BIOS if said service application has not reached a predetermined point after a predetermined amount of time.

30. The computer system according to claim **29** further comprising code for initiating a predetermined reboot protocol if said service application has not reached said predetermined point after said predetermined amount of time.

31. The computer system according to claim **27**, wherein said service button is accessible to a user from an external side of said computer system.

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